NAME (from your UF ID): _____ UF ID#: _____

(Please **PRINT**)

---------- CEN 4072/6070 Software Testing & Verification ----------

Quiz 3 -- Spring 2017

You have 30 minutes to work on this quiz. It is a "closed-book/closed-notes" test. Pay attention to point values, since you may not have time to work all 3 problems.

PRINT your name and UF ID# above NOW and sign the pledge at the bottom of this page, if appropriate, when you are finished.

PLEASE PRINT **– do NOT write *cursively* –** ANSWERS IN THE SPACE PROVIDED ONLY – **NOT IN THE MARGINS** – PREFERABLY USING A BALLPOINT PEN TO INCREASE LEGIBILITY. Good luck!

On my honor, I have neither given nor received unauthorized aid on this exam and I pledge not to divulge information regarding its contents to those who have not yet taken it.

_____

SIGNATURE

1. a. (3 pts.) Give the antecedents ("initialization, preservation, and finalization") to complete the **Repeat_Until** Rule of Inference (ROI) given in the Solution Notes of Problem Set 5:

{P} repeat S until b {Q}

b. (3 pts.) Consider the following assertion of weak correctness. (You may assume that N represents the number of elements in integer array List[1:N] and that the value of integer variable Index is always ≤ N.)

{N≥1}

```
Index := 0
repeat
   Index := Index+1;
   Found := (Key=List[Index])
until (Found OR Index=N)
```

{(Found ∧ Key=List[Index]) ∨ (¬Found ∧ ∀ (1≤i≤N) • key≠List[i])

Which one of the following expressions could be used as a Q-adequate Invariant to prove this assertion using the **Repeat_Until** ROI given in the Problem Set 5 Solution Notes? (Circlle ONE only.)

i. (Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (Index<i≤ N) • Key≠List[i])

ii. [(Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (i ∈ [1,Index) U (Index,N]) • Key≠List[i])] ∧ iorder (where iorder = ∀ 1≤i<N • List[i]≥List[i+1])

iii. (Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i])

iv. Key=List[Index] V (¬Found)

v. (Found ∧ Key=List[Index] ∧ ∀ (1≤i<Index) • Key≠List[i])

vi. (Found ∧ Key=List[Index] ∧ ∀ (1≤i<Index) • Key≠List[i]) V (¬Found)

vii. true

c. (12 pts.) Use the Q-adequate Invariant expression you identified in (b) above to prove that the "Initialization" and "Preservation" antecedents (only) of the **Repeat_Until** ROI for the given assertion hold. **Simplify logical expressions where appropriate and show <u>all</u> steps, including the effect of each individual assignment statement.**

(cont'd)

i. Proof that "Initialization" holds:

ii. Proof that "Preservation" holds:

2. (10 pts.) Consider the assertion of ***weak*** correctness: {z<0} S {y=z+1} where z,y are integers. Which of the following observations/facts **would** allow one to deduce that the assertion is false, and which **would not**? Circle either "would" or "would not" as appropriate, considering the observations individually. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the problem.

   a. When the initial value of z is -1, S terminates and the final value of y is NOT equal to 0. would would not

   b. When the initial value of z is even, S terminates and the final value of y is even. would would not

   c. When the initial value of z is ≥ -5, S terminates and the final value of y is less than the initial value of z. would would not

   d. When the initial value of z is -17, S terminates and the final value of y is twice the final value of z. would would not

   e. The program S is: would would not

```
while z <> -5 do
    z := z+1;
    y := z+1
end_while
```

3. (10 pts.) Circle either "valid" or "invalid" for each of the following *hypothesized* Rules of Inference. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the problem.

   a. $\dfrac{P \Rightarrow (b \wedge Q)}{\{P\}\ \text{repeat S until b}\ \{Q\}}$? valid invalid

   b. $\dfrac{I \Rightarrow P,\ \{I\}\ S\ \{I\},\ P \Rightarrow Q}{\{P\}\ \text{repeat S until b}\ \{Q\}}$? valid invalid

   c. $\dfrac{(\neg b) \Rightarrow (P \wedge Q)}{\{P\}\ \text{while b do S}\ \{Q\}}$? valid invalid

   d. $\dfrac{\{\text{true}\}\ S\ \{I\}\ \text{strongly},\ (I \wedge b) \Rightarrow Q}{\{P\}\ \text{repeat S until b}\ \{Q\}\ \text{strongly}}$? valid invalid

   e. $\dfrac{\{\text{true}\}\ \text{if b then S}\ \{\neg b \wedge Q\}\ \text{strongly}}{\{P\}\ \text{while b do S}\ \{Q\}}$? valid invalid